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50. Internationales Wissenschaftliches Kolloquium
Technische Universität Ilmenau
19.-23. September 2005

Prof. Dr.-Ing. Hans-Joachim Bargstädt M.Sc. / Dipl.-Ing. (Arch.) Arno Blickling

Simulation of construction processes with game development software

ABSTRACT

In the construction industry experiences on site have shown that logic of processes can hardly be found. In most cases there is a need for short-term situational simulations. Nevertheless there seem to be areas where a logical order of processes can be presumed. The presented poster shows a prototype with logic for earthmoving processes implemented with a computer game development engine. The result is an interactive computer game that allows the user to play the simulation of excavation in real-time.

A computer game for earthmoving processes

As Martinez and Ioannou [1] show the logic of processes for earthmoving can be described with ´activity cycle diagrams´ (ACDs). The process has been divided into four main ac-tivities. These are ´PushLoad´, ´Backtrack´, ´Haul´, ´DumpAndSpread´ and ´Return´. Figure 1 visualizes the concept in a graphical way.

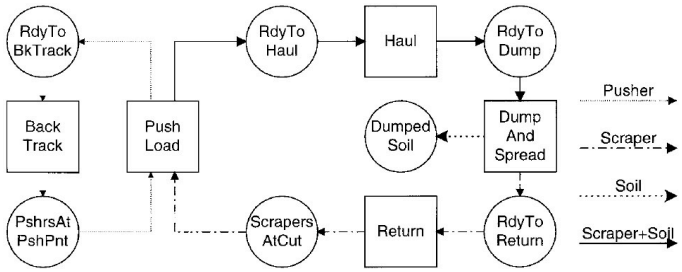

Figure 1: ACD for Scraper and Pusher Operation [Martinez and Ioannou 1999, p. 266].

Rojas and Mukherjee [2] mention later: *´An activity cannot occur if the condition is not ful-filled and when it occurs it always produces the pre-dicted outcome.´* They further mention that *´(..) discrete items change state as events occur in the simulation. The state of the model changes only when those events occur.´* This statement has led to the idea of developing a tool that allows to change the state of the model through user interaction. To assure the most convenient way of deciding when and

where the state of the model should be changed the user is supposed to get visual feedback from the virtual environment of the site. Besides he is supposed to ´steer´ the process model using mouse and keyboard. Associated to this Bargstädt and Blickling [3, 4] have pointed out that the change to a high level of detail in the process model requires analysis of the impact on simulation.

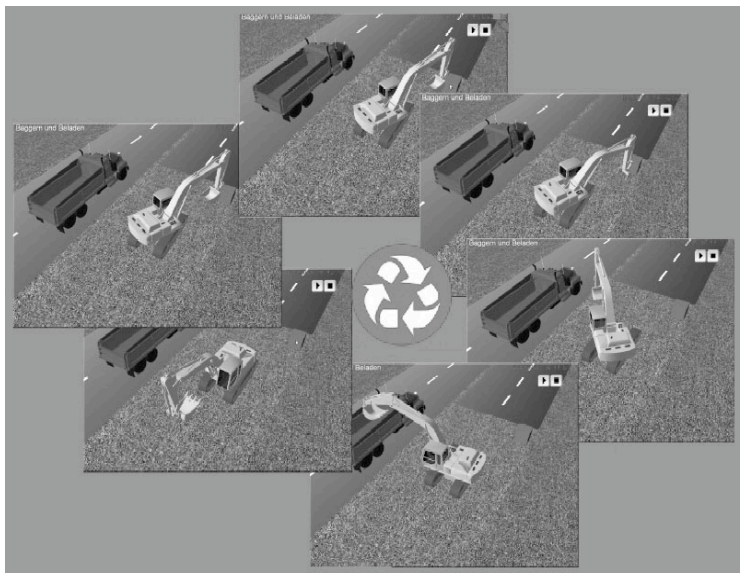

Figure 2: high level of detail in the real-time construction simulation

The excavation process is initiated by user input and causes the excavator to rotate the shovel to the chosen position. After this the movements of the excavator are animated in real-time what is important for the correct determination of the process duration (see Figure 2). A ´virtual clock´ writes the durations of the processes in an external database and stores them for later analysis and reuse. The prototype runs without specific high-end equipment on an ordinary personal computer.

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